Simpson
INSTRUMENTS THAT STAY ACCURATE
CUSTOMER SERVICE

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Pride in Service
NASM MEMBER

OEM SERVICE BULLETIN
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MODEL 461-2

DIGITAL MULTIMETER

NOTICE

This publication is intended solely for use by Simpson Authorized Service Centers. When this document is made available to other than Simpson Authorized Service Centers, it is done so strictly as a courtesy and does not constitute authorization to repair, calibrate, and/or in any way service Simpson products. REPRODUCTION FOR USE BY OTHERS IS PROHIBITED.

To the best of our knowledge and at the time written, the information contained in this Service Bulletin is technically correct and the procedures accurate and adequate to effect the repair and to conduct the performance tests required to assure the unit's compliance with its original advertised specifications.

Simpson Electric Company supplies this service information as a courtesy to the recipient and neither assumes nor accepts any responsibility for any personal injury or equipment damage that may occur during or as a result of tests, wherever performed, whether performed in whole or in part by the recipient of this information; persons employed by the recipient of this information; or any other person that chooses to use the information contained herein; and whether or not using tools and equipment recommended by Simpson.

WARNING

Many of the tests required to troubleshoot, repair, and calibrate this equipment are inherently hazardous. Therefore, troubleshooting, repairing, and calibrating must be performed only by Simpson Authorized Service Centers, and if any such Service Center fails to put the equipment in satisfactory condition, then the factory (National Service Manager) should be promptly notified.

NOTE: Tolerances referenced in the calibration information are the original manufacturer's calibration specification which are maintained on new equipment to assure compliance with the unit's advertised specifications. Repairing equipment used in the field in a wide variety of environments (over a period of time) to these specifications may not be practical or necessary because of cost. However, it is essential that the advertised specifications as given in the operator's manual be met after repairs are made.

SAFETY INFORMATION

Certain Caution and Warning notes are included in appropriate places in this bulletin. These notes are posted as a reminder to Service Personnel to adhere to safe service practices and return the repaired instrument to the customer as the quality product the original design provided.

WARNING

This Instrument is designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument that is used carelessly. Therefore, the following notes must be read carefully and completely, before making any measurements or adjustments. Failure to follow directions can result in a serious or fatal accident.

SHOCK HAZARD: As defined in American National Standard, C39.5, Safety Requirements for Electrical and Electronic Measuring and Controlling Instrumentation, a shock hazard shall be considered to exist at any part involving a potential in excess of 30 volts rms (sine wave) or 42.4 volts DC or peak and where a leakage current from that part to ground exceeds 0.5 milliampere, when measured with an appropriate measuring instrument defined in Section 11.6.1 of ANSI C30.5-1974.

NOTE: The proper measuring instrument for the measurement of leakage current consists essentially of a network of a 1500 ohm non-inductive resistor shunted by a 0.15 microfarad capacitor connected between the terminals of the measuring instrument. The leakage current is that portion of the current that flows through the resistor. The Simpson Model 229 Series-2 AC Leakage Current Tester meets the ANSI C39.5 requirements for the measurement of AC leakage current and can be used for this purpose. To measure DC leakage current, connect a 1500 ohm non-inductive resistor in series with a Simpson 0-500 DC microammeter and use this as the measuring instrument.

Refer to GENERAL SAFETY PRECAUTIONS on next page.

GENERAL SAFETY PRECAUTIONS

The unit is to be serviced only by personnel qualified to recognize shock hazards and trained in the safety precautions required to avoid possible injury. Refer to SHOCK HAZARD definition.

Do not work alone when making measurements where a shock hazard can exist. Notify another person that you are, or intend to make such measurements.

Remember, voltages might appear unexpectedly in defective equipment. An open bleeder resistor can result in a capacitor's retaining a dangerous charge. Remove all power and discharge all capacitors in the circuit being measured and remove all power from the unit before making connections or disconnections. The Instrument itself is well protected against electrical overload. However, the above precautions are wise even in the laboratory, and especially in field usage of the Instrument where many strange or unknown safety hazards might prevail.

Locate all voltage sources and accessibility paths prior to making any measurements or connections.

For your own safety, before each use, inspect the test leads, prods, connectors and power cable for cracks, breaks, or crazes in the insulation. If any defects exist, destroy and replace the defective item(s) immediately.

Do not make measurements in a circuit where corona is present. Corona can be identified by a pale blue color emanating from sharp metal points in the circuit or a buzzing sound, or the odor of ozone. In rare instances, such as around germicidal lamps, ozone might be generated as a normal function. Ordinarily, the presence of ozone indicates presence of high voltage, and probably a malfunction of some kind.

Hands, shoes, floor and workbench must be dry. Avoid making measurements under humid, damp or other environmental conditions that could effect the dielectric withstanding voltage of the test leads or the Instrument.

For maximum safety, do not touch test leads, circuit, or Instrument while power is applied to the circuit being measured.

Use extreme caution when making measurements in an rf circuit where dangerous composite voltage could be present, such as in an rf amplifier.

Do not use test leads which differ from those originally furnished with the Instruments.

Before the Instrument is used for AC operation, make sure that the "third wire" on the AC power cord is connected to an earth or power line ground.

Do not exceed the maximum input or circuit-to-ground voltage ratings of the Instrument. To do so endangers personal safety and may also damage the Instrument.

GENERAL INFORMATION AND SPECIFICATIONS

SCOPE

This manual contains recommended maintenance and repair information for the Simpson Model 461-2 Digital Multimeter. Service should only be performed by those centers having the proper equipment to perform the calibration procedures. The service technician should thoroughly understand the functions and operation of the unit before attempting any procedure in this manual. In case of difficulty, the Instrument should be returned to the factory.

GENERAL DESCRIPTION

The Simpson Model 461-2 is a compact, lightweight, digital multimeter. Features are 3½ digit display, pushbutton power, function, and range switches. Five ranges of AC and DC voltage in addition to five current ranges and six resistance ranges afford good accuracy and provide for versatile and simplified operation. The Model 461-2 is self-contained and may be operated using its battery and/or the AC line (with the AC adapter) which makes it suitable for field or bench use. The Analog-to-Digital (A/D) Conversion Circuitry is contained in one Large-Scale Integration (LSI) Module which provides high reliability and compact design.

TECHNICAL SPECIFICATIONS

Table 1-1

Specifications

1. DC Volts

RANGE	MAXIMUM INDICATION	INPUT IMPEDANCE	OVERLOAD	MINIMUM REJECTION NORMAL MODE	MINIMUM REJECTION COMMON MODE	FULL RANGE RESPONSE TIME
				(db 60Hz)	(db 60Hz)	
200mV	±199.9mV					
2 V	±1.999 V					
20 V	±19.99 V	10MΩ	±1000V	55	120	1 second
200 V	±199.9 V		DC+PEAK AC			
1000 V	±1000 V					
	(MAX INPUT)					

2. AC Volts (AVERAGE - SENSING, RMS CALIBRATED SINE WAVE)

RANGE	MAXIMUM INDICATION	INPUT IMPEDANCE	OVERLOAD (DC+PEAK AC)	FULL RANGE RESPONSE TIME
200mV	199.9mV		750 V	
2 V	1.999 V	10MΩ	750 V	
20 V	19.99 V	100pfd	1000 V	3 seconds
200 V	199.9 V		1000 V	
750 V	750 V		1000 V	
	(MAX INPUT)			

Table 1-1
Specifications (continued)

3. DC Current

RANGE	MAXIMUM INDICATION	FULL RANGE VOLTAGE DROP	OVERLOAD	FULL RANGE RESPONSE TIME
200µA	±199.9µA	200mV	±2.0A	1 second
2mA	±1.999mA			
20mA	±19.99mA			
200mA	±199.9mA			
2000mA	±1999 mA			

4. AC Current

RANGE	MAXIMUM INDICATION	FULL RANGE VOLTAGE DROP	OVERLOAD	FULL RANGE RESPONSE TIME
200µA	199.9µA	200mV	2.0A	3 seconds
2mA	1.999mA			
20mA	19.99mA			
200mA	199.9mA			
2000mA	1999 mA			

5. Resistance

RANGE	MAXIMUM INDICATION	OPEN CIRCUIT VOLTAGE	OVERLOAD	FULL RANGE RESPONSE TIME
200Ω	199.9Ω	< 3V	250VRMS	1 second
2kΩ	1.999kΩ			
20kΩ	19.99kΩ			
200kΩ	199.9kΩ			
2000kΩ	1999 kΩ			3 seconds
20MΩ	19.99MΩ			

6. Accuracy

A. DC Volts: ±.1% + 1 Digit (From +18° To +28°C)

B. AC Volts: % of Input + Number of Digits (From +18°C To +28°C)

RANGE	20Hz To 400 Hz	400Hz To 1kHz	1kHz To 10kHz
200mV	± .5% + 2 Digits	± .5% + 2 Digits	± 5% + 2 Digits
2V	± .5% + 2 Digits	± .5% + 2 Digits	± 5% + 2 Digits
20V	± .5% + 2 Digits	± .5% + 2 Digits	
200V	± .5% + 2 Digits	± .5% + 2 Digits	
750V	± 1% + 3 Digits		

Table 1-1
Specifications (continued)

C. DC Current:

Range(s) 200µA,2mA,20mA, ±(.5% + 2 Digits),(From +18°C To 28°C)

200mA,2000mA, ±(.75% + 2 Digits),(From +18°C To 28°C)

D. AC Current: (From +18°C To +28°C)

RANGE	20Hz To 1kHz
200µA	±1% + 2 Digits
2mA	±1% + 2 Digits
20mA	±1% + 2 Digits
200mA	±1.5% + 2 Digits
2000mA	±1.5% + 2 Digits

E. Resistance:

Range(s) 200Ω,2kΩ,20kΩ,
200kΩ,2000kΩ ±(.25% + 2 Digits),(From +18°C To 28°C)

2MΩ ±(.75% + 2 Digits),(From +18°C To 28°C)

7. Rated Circuit-To-Ground Voltage⚠(Maximum Common Mode Voltage)

300 Volts (DC plus peak AC) Maximum from "-"(Minus) measuring terminal to the power line (earth) ground.

8. Conversion Rate 3 readings per second, nominal

9. Display

Numerical
Display: 3½ Digit, 7 Segment LEDs. Display "blanks OUT" except for MSD "1" at 2000 counts and above.

DC Polarity
Display: Automatic "-" sign displayed; "+" sign is implied (not indicated)

10. Temperature Range

Operating: 0° To +55°C
Storage: -40°C To +60°C

Table 1-1
Specifications (continued)

11. Relative Humidity

Operating: 0 To 90% (non-condensing)

12. Temperature Coefficient

(0°C To +18°C and +28°C To +55°C). Less than 0.1 times the applicable accuracy specification per °C.

13. Transient Protection

Protected against transients on all voltage and resistance ranges: 6KV at 100μsec. max.

INSTALLATION AND OPERATION

GENERAL

The instructions for use and operation of the 461-2 are contained in the Operator's Manual part number 6-111623. This section contains information concerning the general power requirements of the Model 461-2 and how they are provided. Battery and fuse replacement procedures are also included.

OPERATING POSITION

The Model 461-2 will operate in any position, however, it is usually placed horizontally or in an inclined position for easy viewing of the numerical display.

POWER REQUIREMENTS

Two 2.50V nickel-cadmium (NiCAD) cells are required for operation. Battery operation provides complete isolation from the power line and permits operation where an AC line is unavailable. With a full charge, the Model 461-2 can be operated continuously for a nominal 8 hours when using the recommended batteries. Recharging requires an AC adapter connected to a line source and then plugged in the charger jack. When completely discharged, a nominal 12 hours is required for a complete recharge (the power switch must be in the "off" position, or the batteries will not charge at this rate).

CAUTION

Do not operate the Model 461-2 without the batteries installed.

WARNING

Remove all power and input connections to the Instrument before removing rear cover.

BATTERY INSTALLATION/REPLACEMENT

1. Remove the rear cover and remove retainer tubes with old batteries from the battery holder board.

2. Insert one 2.50V cell in each retainer.

3. Insert the retainers into the battery holder. Observe polarity as marked on the battery holder board. Be sure good contact is made with the battery holder clips.

4. Replace the rear cover.

CAUTION

Do not operate the Model 461-2 without first charging the batteries. All newly purchased cells are completely discharged. Charge all new cells at least 15 minutes before initial operation. Use nickel-cadmium cells only, this will avoid recharging dangers.

FUSE REPLACEMENT

In the Model 461-2 there are two fuses: one is located next to the battery holder (F1) while the other (F2) is located on the range board inside the Instrument. Replacement of F1 requires only the removal of the rear cover. Replacement of F2 requires that the front case also be removed (refer to Part Three). To replace F2 carefully separate the function board from the range and battery board by grasping the sides of the range board and pulling the function board away. F2 is now accessible.

CALIBRATION

WARNING

Voltages can be encountered during the process of operating, calibrating, testing, or servicing the Instrument that constitute a Shock Hazard (Refer to Preface). Therefore, make sure that the GENERAL SAFETY PRECAUTIONS (Refer to Preface) are carefully read and understood before putting the Instrument into operation, performing maintenance, or any disassembly. Do not forget to perform the Hi-Pot Test Procedure for leakage check which is shown on Page 3-8 of this bulletin.

GENERAL

Procedures for disassembly, part replacement, calibration, and performance testing are contained in this section. Before attempting any of the procedures in this section, maintenance personnel should be thoroughly familiar with the operator's manual, specifications, physical composition and theory of operation of the Model 461-2.

DISASSEMBLY PROCEDURES

Three parts make up the procedure for complete disassembly: removal of the rear cover, of the front case and of the function board. Removal of the front case constitutes removal of the function board, which is required for removal of individual components.

Rear Cover Removal

1. De-energize the Instrument and remove all test leads.
2. Place the Instrument on a padded surface to prevent the case and/or the display window from being scratched or marred.
3. Loosen the two captive screws from the rear cover and remove the cover.
4. Reverse the steps to replace the cover.

Front Case Removal

1. Remove the rear cover.
2. Loosen the two spacer studs holding the battery holder board in place and remove.

3. Grip the battery circuit board and carefully slide the range and function p.c. boards out of the front case.

Range and Function Board Removal

1. Grip the sides of the range board in one hand and the function board in the other and carefully pull the boards apart.

2. To remove the shields from the function or range board, grip the board in one hand and the shield in the other and carefully separate the shield pins from the p.c. board being careful not to break the two connecting pins on the shield.

3. Reverse these procedures to replace the boards. Be sure the p.c. boards are in the mounting grooves before sliding them forward into the case or the pushbuttons on the front of the boards will not match the holes in the front case.

Replacing The Battery Holder Board

1. Remove the rear cover, case and function board.

2. Unsolder the solder connections from the range board and battery board and remove the battery board assembly.

3. To replace the battery board assembly, reverse these steps.

Switch Replacement

1. Remove the range, function p.c. board and shields.

2. Unsolder all switch contacts. NOTE: Use a desoldering tool.

3. Gently lift off the switch, or switches, noting the orientation.

4. To replace the switch, or switch assembly, insert the new contacts into the clean desoldered holes in the p.c. board.

5. Carefully resolder all contacts and check for solder bridges.

6. Perform an operational test. If the unit passes, replace the front and rear cases.

Display Panel Replacement

1. Remove the front and rear case. Separate the function and range boards and remove the shield from the function board.

2. Place the function p.c. board on a padded surface, component-side down, when removing the readout board, or, component-side up, if removing a LED.

3. Unsolder all contacts of the part being removed, using a desoldering tool.

4. Insert the new assembly into the correct holes, resolder and test.

NOTE

Each digit on the display panel is replaceable. Use a desoldering tool when removing solder from each pin/board connection. Also, when replacing an element (LED), be sure that the decimal point of the LED being replaced is aligned with all of the other digit decimal points.

CALIBRATION (GENERAL)

Equipment Required

The test equipment listed in Table 4-1 is required to calibrate the Model 461-2. The specifications listed are the minimum necessary to ensure accurate calibration. All test equipment should be correctly calibrated and operated in accordance with the manufacturer's instructions.

Table 4-1

Required Test Equipment

Standard	Range	Accuracy
DC Voltage Standard	0-1000V	.01%
AC Voltage Standard	0-200V, 20Hz To 1kHz 0-750V, 20Hz To 400Hz 0-2V, 1kHz To 10kHz	.05% .1% .5%
Decade Resistance Box	0-2MegΩ 0-20MegΩ	.025% .075%
DC Current Standard	0-20mA 0-2Amp	.05% .07%
AC Current Standard	0-20mA, 20Hz To 1kHz 0-2Amp, 20Hz To 1kHz	.1% .15%
High-Pot Tester	0-1200VAC	3%

Calibration Conditions

All calibration procedures should be performed under the following conditions:

1. Power input: batteries fully charged

2. Ambient temperature: +18°C To +28°C

3. Relative humidity: 20 - 60%

Perform the calibration procedures in the manner and sequence listed. Allow all test equipment a 15 minute warmup period before calibrating. Refer to Figure 4-1 and 4-2 for control locations.

When calibrating the Instrument, do not place it close to strong AC fields or other sources of interference.

NOTE

Procedures in this section may refer to the required input of readings in terms of "counts". A "count" of 2000 represents full range while a "count" of 1000 represents half range, etc.

Calibration Procedure

1. Connect the input leads of the Instrument (Model 461-2) under test to a DC voltage standard.

   A. Set function to DC and V positions, range 200mV, apply +170.00mV and adjust R211 for a display of 170.0.

   B. Function DC and V positions, range 2V, apply +1.700V, adjust R213 for a display of 1.700.

2. Disconnect the leads from the DC voltage source and connect them to a resistance decade box.

   A. Set function to KΩ and DC positions, and set range to 2. Apply 1.700KΩ and adjust R221 for a display of 1.700.

3. Disconnect the leads from the decade box and connect them to an AC voltage standard.

   A. Set function to AC and V positions, and set range to 2V. Apply 1.600VAC, 400Hz and adjust R227 for a display of 1.600.

   B. With the function at AC and V positions, set the range to 20V. Apply 17.00VAC, 1kHz, and adjust C105 for a display of 17.00.

   C. With the function at AC and V positions, set the range to 200V. Apply 190.00VAC, 1kHz, and adjust C103 for a display of 190.0.

   D. Disconnect the leads from the AC voltage standard.

WARNING

The following test involves voltages that can be dangerous and fatal. Observe the GENERAL SAFETY PRECAUTIONS listed in the Preface at all times.

Performance Test

These tests verify that the Model 461-2 is operating properly. If a unit fails any test, an appropriate repair or re-calibration should be performed. Perform all tests using the following tables.

DC Voltage Tests (461-2 Function Switch to V and DC Positions)

INPUT	RANGE	DISPLAY	ADVERTISED TOLERANCE (IN COUNTS)
SHORT	200mV	±00.0	±1
±170.0mV		±170.0	±5
±250.0mV		(ALL DIGITS BLANK EXCEPT MSD1)	
SHORT	2V	.000	±1
±250.0mV		±.250	±2
±1.700V		±1.700	±5
SHORT	20V	0.00	±1
±17.00V		±17.00	±5
SHORT	200V	00.0	±1
±190.0V		±190.0	±6
SHORT	1000V	000	±1
±900.0V		±900	±3

DC Current Tests (461-2 Function Switch to mA and DC Positions)

INPUT	RANGE	DISPLAY	ADVERTISED TOLERANCE (IN COUNTS)
SHORT	200µA	±00.0	±1
±170.0µA		±170.0	±11
±1.700mA	2mA	±1.700	±11
±17.00mA	20mA	±17.00	±11
±170.0mA	200mA	±170.0	±19
±1000mA	2000mA	±1000	±12

Resistance Tests (461-2 Function Switch to KΩ and DC Positions)

INPUT	RANGE	DISPLAY	ADVERTISED TOLERANCE (IN COUNTS)
SHORT	200Ω	00.0	±3
100.0Ω		100.0	±8
1.000kΩ	2kΩ	1.000	±5
10.00kΩ	20kΩ	10.00	±5
100.0kΩ	200kΩ	100.0	±5
1000kΩ	2000kΩ	1000	±5
10MΩ	20MΩ	10.00	±10

WARNING

The following test involves voltages that can be dangerous and fatal. Observe the GENERAL SAFETY PRECAUTIONS listed in the Preface at all times.

Performance Test (Continued)

AC Voltage Tests (461-2 Function Switch to V and AC Positions)

INPUT	RANGE	DISPLAY	ADVERTISED TOLERANCE (IN COUNTS)
SHORT	ALL	000	±2
*170.0mV	200mV	170.0	±11
*1.700V	2V	1.700	±11
*17.00V	20V	17.00	±11
*190.0V	200V	190.0	±11
**750.0V(MAX)	750V	750	±11

*Check at 50Hz and 1kHz
**Check at 50Hz and 400Hz

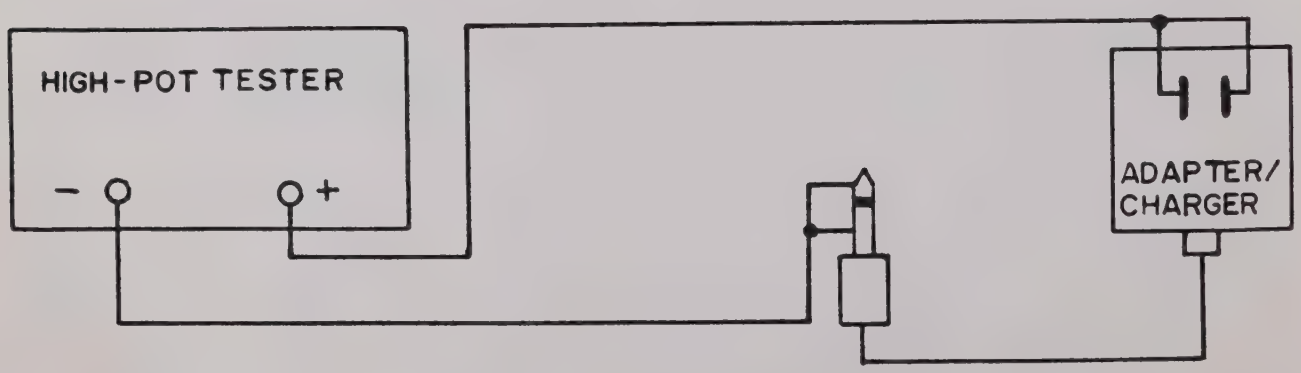
AC Current Tests (461-2 Function Switch to mA and AC Positions)

INPUT	RANGE	DISPLAY	ADVERTISED TOLERANCE (IN COUNTS)
SHORT	200µA	0	±2
*170.0µA		170.0	±19
*1.700mA	2mA	1.700	±19
*17.00mA	20mA	17.00	±19
*170.0mA	200mA	170.0	±28
*1000mA	2000mA	1000	±17

*Check at 400Hz

This completes the performance tests. Disconnect the test equipment if the unit passed all tests and proceed to the following HI-POT test.

Figure 3-1. HI-POT TEST



HI-POT TEST

Safety Precautions

This test must be performed after any and all repair or calibration. Because the AC adapter isolates the Model 461-2 circuit common from the AC power line ground, the AC adapter must be HI-POT tested using the following procedure.

NOTE

The Model 461-2 printed circuit boards, shields and case must be thoroughly inspected before final reassembly. All excess solder, lead clippings, and other debris must be removed.

WARNING

The following test involves voltages that can be dangerous and fatal. Therefore, the following safety precautions and test procedures must be read very carefully and followed rigorously.

1. The "HI-POT" (high potential tester) used for these tests must be a so-called "non-destructive" type designed especially to limit the test current and to reduce the risk of injury to the operator from accidental electric shock. Avoid home-made power supplies — they can be dangerous if not designed for the purpose.

2. Do not make high voltage tests while alone. Make certain that a nearby person capable of rendering aid is being watchful.

3. Read and fully understand the operating instructions for the hi-pot tester before using it.

4. Never touch the test leads or anything connected to them until the voltage control has been returned to zero and the hi-pot tester's POWER switch has been turned OFF.

5. The workplace must be cleared of any metal objects (except the hi-pot tester) that could be touched accidentally during testing. Keep yourself insulated from everything including grounded objects. Stand on a rubber mat over concrete or metal floor.

6. Make it a habit to keep one hand in a pocket or behind you whenever the hi-pot POWER switch is ON.

7. Place the item to be tested so that you cannot accidentally touch it while handling the hi-pot tester controls.

Hi-Pot Test Procedure

1. Review the safety precautions above.

2. Short together the tip and sleeve of the adapter/charger output plug and connect to the "common" hi-pot tester lead. Reference Fig. 3-1.

3. Short together the power receptacle prongs on the adapter/charger and connect to the "hot" hi-pot tester lead. Reference Fig. 3-1.

4. Turn the hi-pot tester ON and adjust the voltage control rapidly but smoothly (with no overshoot) to 1000V.

5. Sustain the voltage for sixty seconds observing for evidence of electrical breakdown as indicated by a sudden increase of the test current, a sudden decrease or inability to increase the test voltage, the flashing of a "breakdown" lamp, or an audible crackle or sparking sound, depending on the type of hi-pot tester being used.

6. After 60 seconds, or if breakdown occurs, rapidly but smoothly, reduce the test voltage to zero and turn the hi-pot tester POWER switch to OFF.

CAUTION

Never turn the hi-pot tester POWER switch OFF while the test voltage is being applied. The resulting transient may damage the item being tested and a faulty unit may unknowingly be shipped to the customer.

When the hi-pot tester voltmeter indicates zero volts, disconnect the test leads.

A failure of the test indicates a fault in the unit that must be corrected and re-tested before returning the unit to the customer.

NOTE

Hi-pot testing can be harmful to the item being tested. Do not repeat a test more than once.

7. Remove "hi-pot" wiring from the adapter/charger power prongs and output plug.

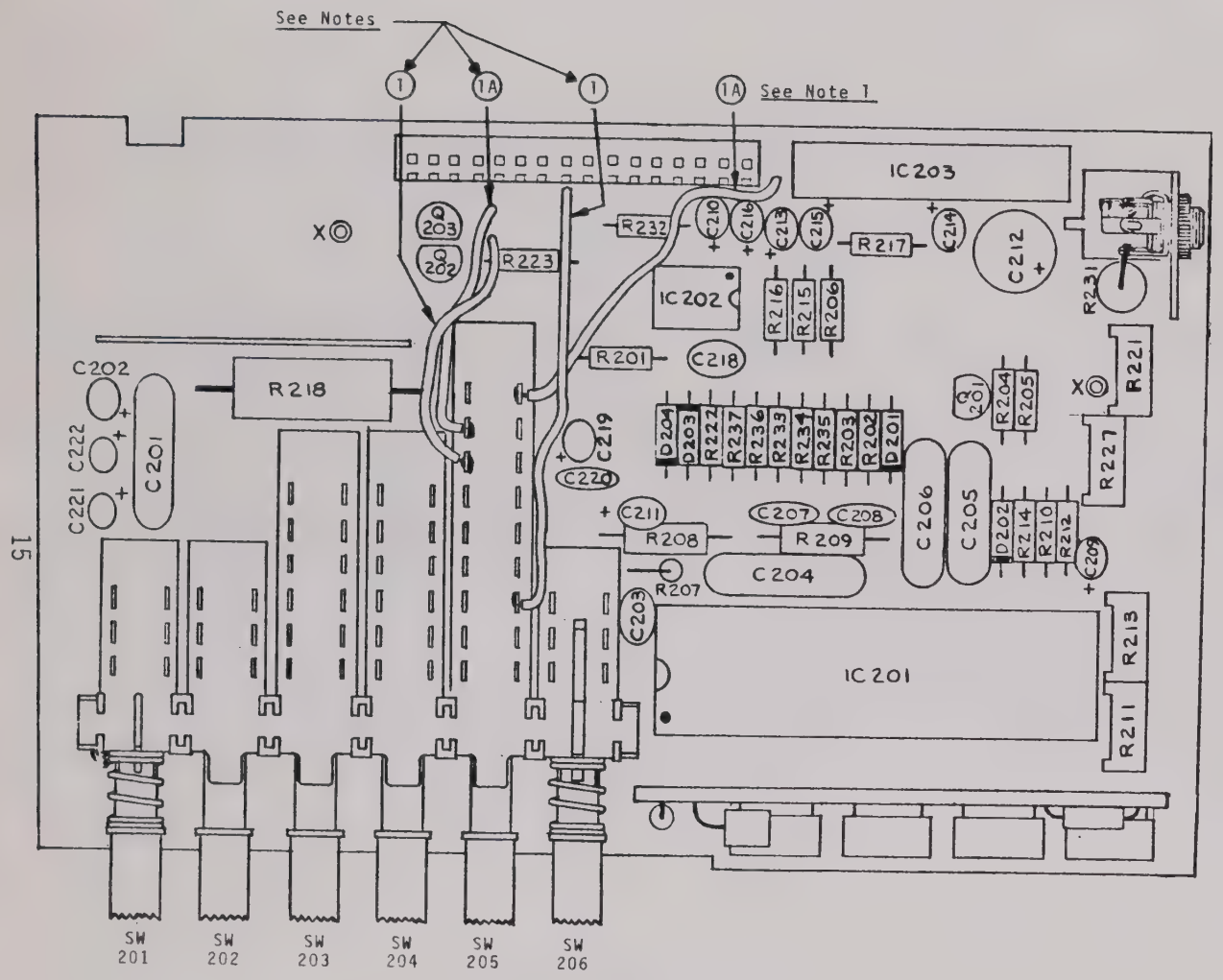


Figure 4-2
Function PC BD Parts

NOTES:

1. Position items (1) & (1A) (all) exactly as shown or frequency problems will result.
2. Items (1) & (1A) must be positioned close to the AC board surface, keeping Item (1) on top of Item (1A).

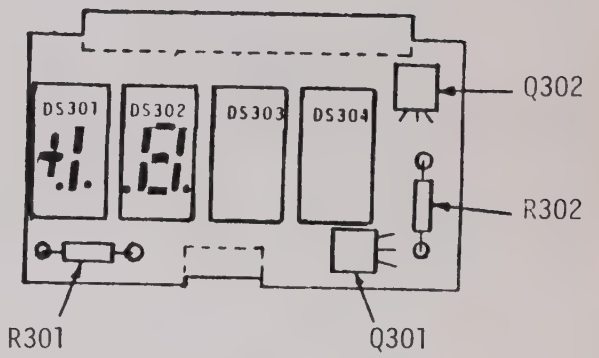
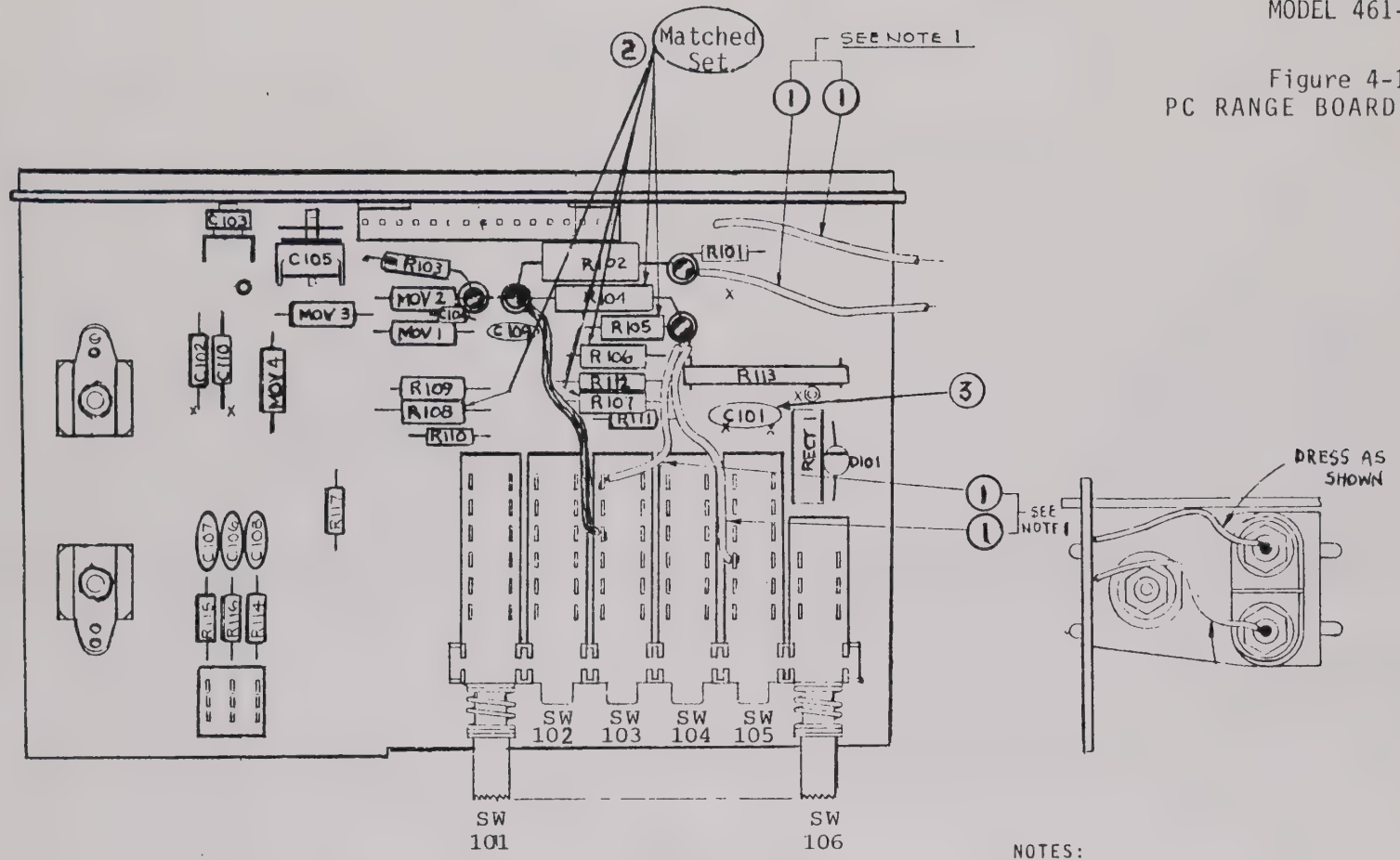
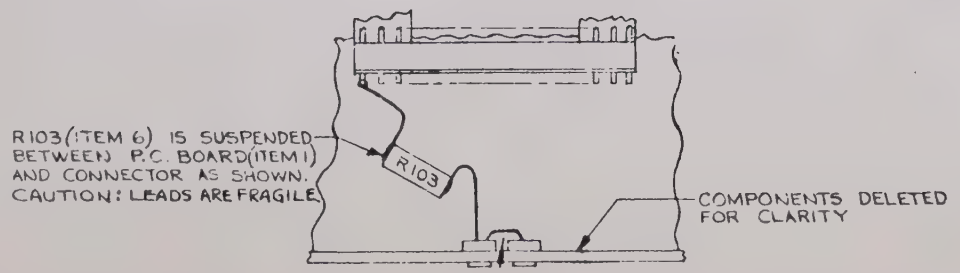


Figure 4-3
Display BD Parts

Figure 4-1
PC RANGE BOARD ASSEMBLY




R103(ITEM 6) IS SUSPENDED BETWEEN P.C. BOARD(ITEM 1) AND CONNECTOR AS SHOWN. CAUTION: LEADS ARE FRAGILE.
R103
COMPONENTS DELETED FOR CLARITY

NOTES:

1. Position items (1) exactly as shown or frequency problems will result.
2. Matched resistor set correlation.

R104	9M
R105	900K
R106	90K
R107	9K
R108	1K

3. To compensate for ckt. capacity in meeting frequency spec. it may be necessary to shunt C101 with a second 6111631 82pf capacitor.

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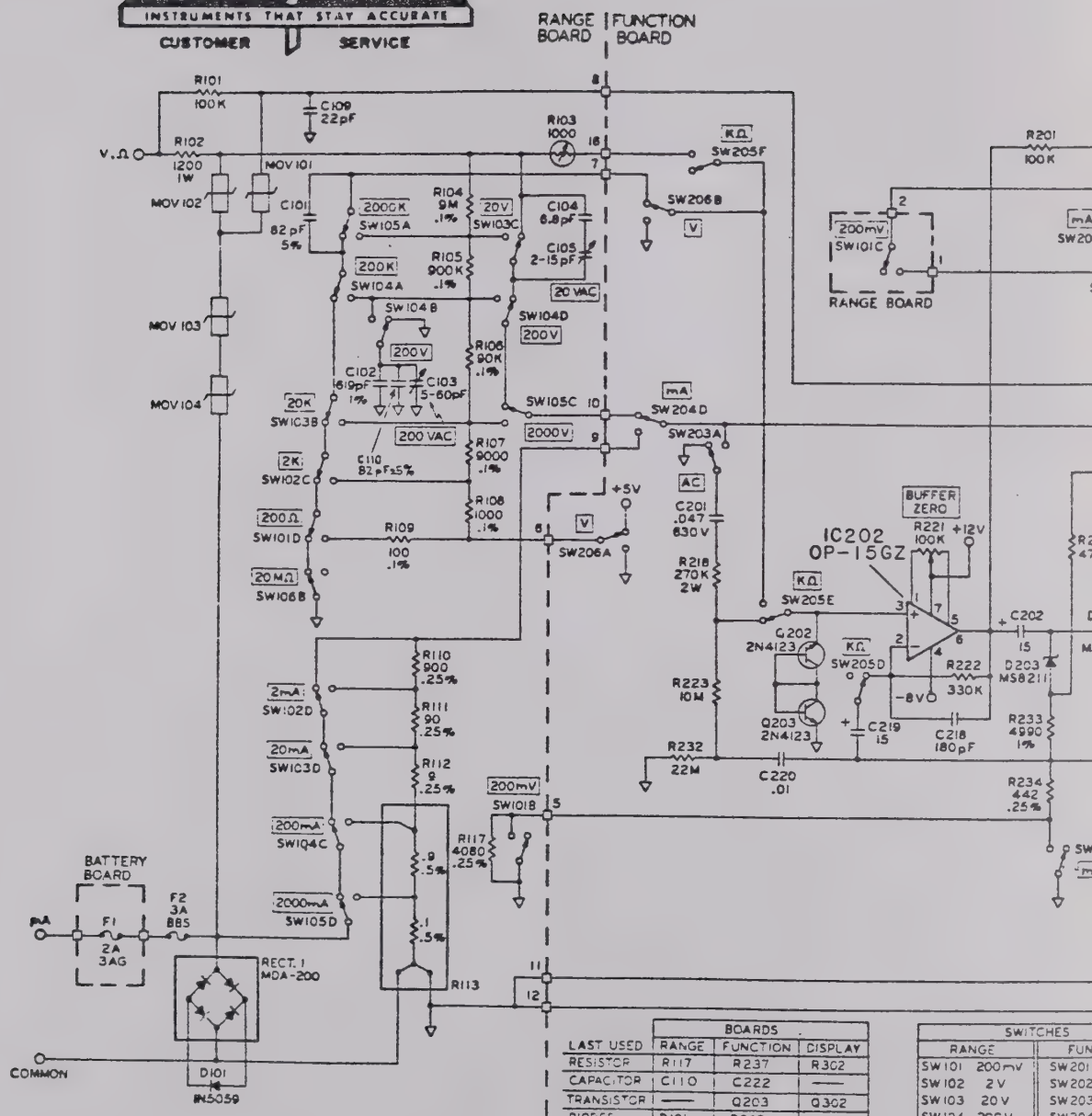
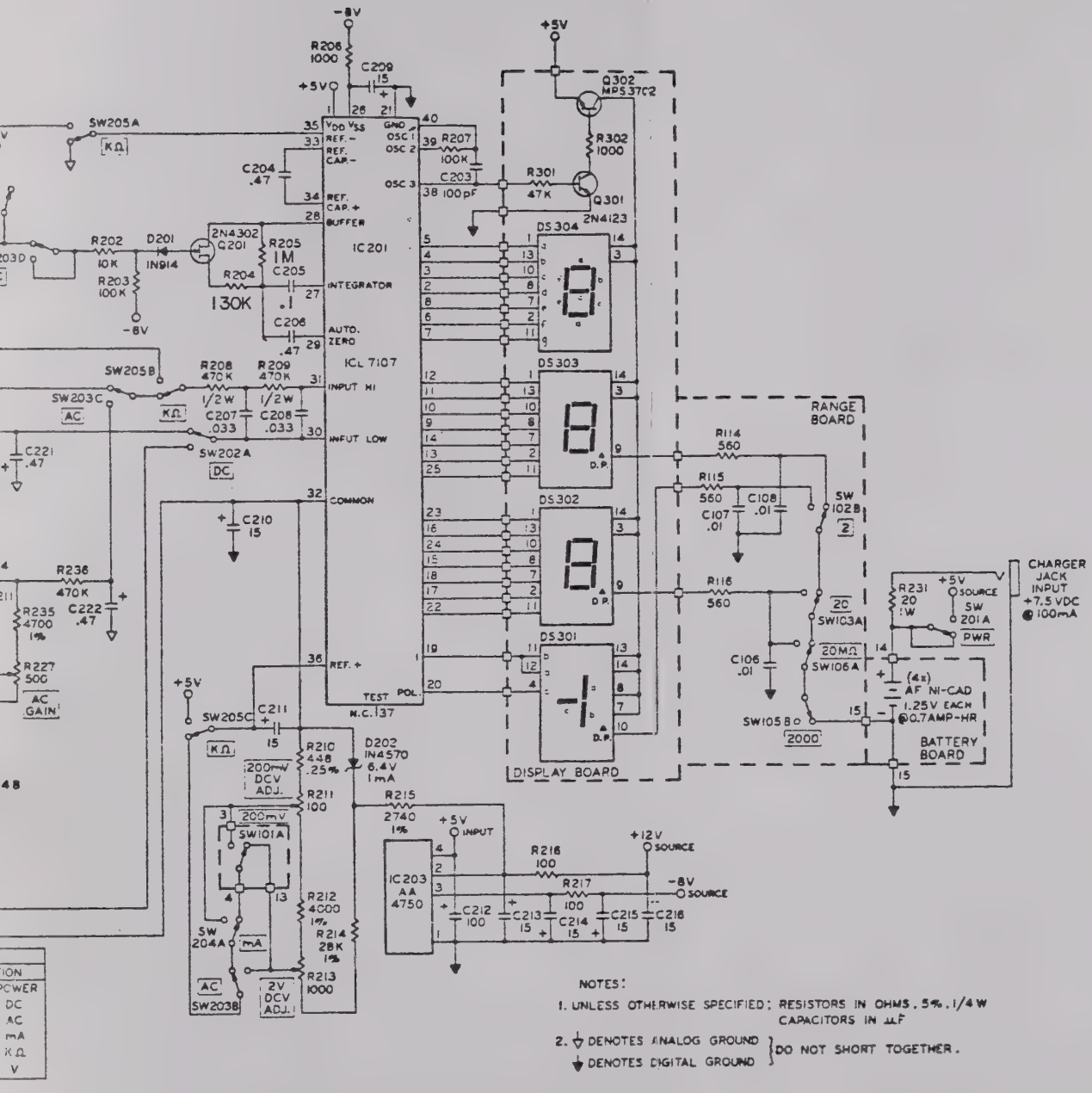
INSTRUMENTS THAT STAY ACCURATE
CUSTOMER SERVICE



LAST USED	BOARDS RANGE	FUNCTION	DISPLAY
RESISTOR	R117	R237	R302
CAPACITOR	C110	C222	——
TRANSISTOR	——	Q203	Q302
DIODES	D101	D202	——
INTEGRATED CIRCUIT	——	IC203	——
DISPLAY	——	——	DS304

SWITCHES RANGE		FUN
SW101	200mV	SW201
SW102	2V	SW202
SW103	20V	SW203
SW104	200V	SW204
SW105	2000V	SW205
SW106	20 MΩ	SW206

NOT USED: R118, R119 RANGE BOARD
R219, R220, R224, R225, R226, R228, R229, R230, C217 } FUNCTION BOARD



NOTES:

1. UNLESS OTHERWISE SPECIFIED: RESISTORS IN OHMS, 5%, 1/4 W
   CAPACITORS IN μF
2. ⏚ DENOTES ANALOG GROUND
   ⏚ DENOTES DIGITAL GROUND
   } DO NOT SHORT TOGETHER.

Model 461-2

SIMPSON ELECTRIC COMPANY
853 DUNDEE AVENUE
ELGIN, ILLINOIS 60120
PHONE 697-2260

DIGITAL/OSCILLOSCOPE/SPECIAL PRODUCTS

MODEL 461-2 DIGITAL MULTIMETER 1980-

PART NUMBER	DESCRIPTION		PRT REF	SPECIAL INFORMATION
05-118168	RES 100K	1/4W 5.0%	R201	
05-118161	RES 1CK	1/4W 5.0%	R202	
05-118168	RES 100K	1/4W 5.0%	R203	
05-118166	RES 39K	1/4W 5.0%	R204	
05-115965	RES 330K	1/4W 5.0%	R205	
05-118155	RES 1K	1/4W 5.0%	R206	
05-118168	RES 100K	1/4W 5.0%	R207	
01-114227	RES 47CK	1/2W 5.0%	R208	
01-114227	RES 47CK	1/2W 5.0%	R209	
05-118411	RES 448.0 OHM	1/4W 1/4%	R210	
05-119993	POT 10C.0 OHM	1/2W 20%	R211	
05-117695	RES 4K	1/4W 1.0%	R212	
05-119994	POT 1K	1/2W 20%	R213	
05-117499	RES 28K	1/4W 1.0%	R214	
05-114496	RES 2.74K	1/4W 1.0%	R215	
05-118152	RES 10C.0 OHM	1/4W 5.0%	R216	
05-118152	RES 10C.0 OHM	1/4W 5.0%	R217	
06-111664	RES 27CK	2.0W 5.0%	R218	
06-111613	POT 10CK	1/2W 20%	R221	
05-115965	RES 330K	1/4W 5.0%	R222	
05-116632	RES 1C.0 MEG	1/4W 5.0%	R223	
06-111611	POT 50C.0 OHM	1/2W 20%	R227	
06-110123	RES 2C.0 OHM	1.0W 5.0%	R231	
05-118756	RES 22.0 MEG	1/4W 5.0%	R232	
05-115502	RES 4.99K	1/4W 1.0%	R233	
06-111633	RES 442.0 OHM	1/4W 1/4%	R234	
05-115501	RES 4.7K	1/4W 1.0%	R235	
05-118169	RES 47CK	1/4W 5.0%	R236	
05-118169	RES 47CK	1/4W 5.0%	R237	
06-111599	CAP C.C47UF	630V	C201	
05-115534	CAP 15UF	16V	C202	
05-113217	CAP 100PF	1KV	C203	
06-111168	CAP .47UF	100V	C204	
06-110364	CAP .22UF	100V	C205	
06-111168	CAP .47UF	100V	C206	
05-117732	CAP .033UF	100V	C207	
05-117732	CAP .033UF	100V	C208	
05-115534	CAP 15UF	16V	C209	
05-115534	CAP 15UF	16V	C210	

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MODEL 461-2 DIGITAL MULTIMETER 1980-

PART NUMBER	DESCRIPTION	PRT REF	SPECIAL INFORMATION
	TESTER SECTION PARTS		
06-111924	RES MATCHED SET M461-2	R104	
10-864397	RANGE BD ASSEM COMP M461-2		
06-110694	RES VARISTOR	MOV101	
06-110694	RES VARISTOR	MOV102	
06-110694	RES VARISTOR	MOV103	
06-110694	RES VARISTOR	MOV104	
05-118625	RES 100K 1/2W 5.0%	R101	
05-116891	RES 1.2K 1.0W 10%	R102	
06-112329	RES 1K HV CURRENT LIMITER	R103	
06-111924	RES MATCHED SET M461-2	R105	
06-111924	RES MATCHED SET M461-2	R106	
06-111924	RES MATCHED SET M461-2	R107	
06-111924	RES MATCHED SET M461-2	R108	
06-111153	RES 100.0 OHM 1/4W 0.1%	R109	
05-116273	RES 900.0 OHM 1/4W 1/4%	R110	
05-116272	RES 90.0 OHM 1/4W 1/4%	R111	
05-118410	RES 9.0 OHM 1/4W 1/4%	R112	
06-111235	RES SPECIAL .1 OHM & .9 OHM	R113	
05-118154	RES 560.0 OHM 1/4W 5.0%	R114	
05-118154	RES 560.0 OHM 1/4W 5.0%	R115	
05-118154	RES 560.0 OHM 1/4W 5.0%	R116	
05-118412	RES 4.02K 1/4W 1/4%	R117	
05-117566	CAP 82PF 63V 5.0%	C101	
06-111622	CAP 619PF 125V 1.0%	C102	
06-110125	CAP VAR 4.5-60PF 250V	C103	
05-110057	CAP 6.8PF 1KV 5.0%	C104	
06-111158	CAP VAR 2-15PF 250V	C105	
05-117969	CAP .01UF 100V	C106	
05-117969	CAP .01UF 100V	C107	
05-117969	CAP .01UF 100V	C108	
05-117042	CAP 22PF 1KV 5.0%	C109	
05-117566	CAP 82PF 63V 5.0%	C110	
06-111240	RECT. BRIDGE	RECT.1	
05-113826	DIODE 1N5059	D101	
	FUNCTION PC BD PARTS		
10-864400	FUNCTION BD ASSEM COMP M461-2		

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PART NUMBER	DESCRIPTION	PRT REF	SPECIAL INFORMATION
05-115534	CAP 15UF 16V	C211	
05-117206	CAP 100UF 10V	C212	
05-115534	CAP 15UF 16V	C213	
05-115534	CAP 15UF 16V	C214	
05-115534	CAP 15UF 16V	C215	
05-115534	CAP 15UF 16V	C216	
05-117569	CAP 180PF 25V	C218	
05-115534	CAP 15UF 16V	C219	
05-117278	CAP .01UF 100V	C220	
05-118564	CAP .47UF 35V	C221	
05-118564	CAP .47UF 35V	C222	
05-112004	DIODE 1N914 SIL	D201	
05-119942	DIODE ZENER 6.4V 1N4570	D202	
05-115784	DIODE SCHOTTKY MS8211	D203	
05-115784	DIODE SCHOTTKY MS8211	D204	
06-110059	TRANS 2N4302 FET	Q201	
05-115931	TRANS 2N4123 NPN	Q202	
05-115931	TRANS 2N4123 NPN	Q203	
06-110919	IC A/D CONV ICL7107CPL	IC201	
06-110628	IC OP AMP LF 356N	IC202	
06-111607	IC DC CONV. AA4750	IC203	
06-180074	BRACKET JACKET MOUNTING	IC201	
06-180074	BRACKET JACK MOUNTING		
	DISPLAY BD ASSEM		
	DISPLAY BD COMP M461-2/2R		
10-864705	CASE ASSEM COMP FRONT		
05-119647	RES 47K 1/4W 5.0%	R301	
05-118155	RES 1K 1/4W 5.0%	R302	
05-115931	TRANS 2N4123	Q301	
05-113864	TRANS MPS3702	Q302	
05-119944	READOUT, LED + OR - 1	DS1	
06-111609	READOUT, LED, 7 SEGMENT	DS2	
06-111609	READOUT, LED, 7 SEGMENT	DS3	
06-111609	READOUT, LED, 7 SEGMENT	DS4	
	BATT BD & MISC COMPONENTS		
10-864395	BD ASSEM BATT COMP M461-2/2R		

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DIGITAL/OSCILLOSCOPE/SPECIAL PRODUCTS

MODEL 461-2 DIGITAL MULTIMETER 1980-

PART NUMBER	DESCRIPTION	PRT REF	SPECIAL INFORMATION
05-117739	CLIP FUSE		
06-111604	CONNECTOR 16 PIN		
06-111614	CLIP BATT		
10-864705	CASE ASSEM COMP FRONT M461-2		
06-112285	OVERLAY WINDOW TOP M461-2		
06-112286	OVERLAY WINDOW BTM M461-2		
06-112348	OVERLAY SWITCH M461-2		
06-111634	OVERLAY SPEC M461-2		
06-590085	STAND VIEWING SUPPORT		
06-110078	CAP STAND FOOT		
06-110068	BUMPER CASE		
10-560311	COVER REAR COMP M461-2/2R		
03-812872	BUMPER FOOT		
06-110072	SCREW SPCL 4-40 X 3/8IN		
05-110564	RING RETAINER E-TYPE		
06-111319	LABEL FUSE ID & CAUTION		
06-181229	SPACER HEX		
01-401861	LOCKWASHER #4 INTERNAL TOOTH		
10-864761	CONN. ASSEM COMP INPUT JACK		
03-260983	HOUSING INPUT JACK M461 SERIES		
06-112410	CONN. PIN PLUG INPUT		
01-401863	LOCKWASHER #8		
06-111620	TERMINAL FLAT LUG		
01-132737	NUT 8-32 X 5/16		
10-864670	SHIELD ASSEM		
06-111649	LABEL INSTRUCTION		
01-112911	FUSE 2 AMP 250V 3AG	F1	
06-110906	FUSE 3A 600V		
06-111600	SWITCH FUNCTION		
06-111602	SWITCH RANGE		
06-110115	BUTTON GREY		
06-110113	BUTTON RED		
06-110114	BUTTON BLACK		
06-110705	BUTTON WHITE		
06-111231	BUSHING TEFLON		
05-117326	CONN. W/NUT		
06-111605	CONN. 16 PIN		
05-117649	CONN. DIGI-CLIP		
06-111603	SOCKET COMPONENT		

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PART NUMBER	DESCRIPTION	PRT REF	SPECIAL INFORMATION
06-161621	SHIELD		
06-111650	LABEL FUSE		
05-119057	CLIP FUSE		
06-111623	INSTRUCTION MANUAL M461-2		
00743	*AC ADAPTER/CHARGER 120VAC		
00746	*AC ADAPTER/CHARGER 230VAC		
00043	*TEST LEADS		

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